PHARMACEUTICS

1st YEAR STUDENTS

PHARMACY INDIA

MASTER NOTES FOR D.PHARMA

- Subject Wise Notes
- According To PCI Syllabus
- Easy To Understand
- Prepared By Experts
- Learn With Flow Charts

Chapter 1

HISTORY, CAREER AND PHARMACOPOEIA

- History of the profession of Pharmacy in India in relation to Pharmacy Education
- History of the profession of Pharmacy in India in relation to Industry, pharmacy practice and various professional associations.
- History of the profession of Pharmacy in India in relation to Pharmacy practice and various professional associations.
- Pharmacy as a career

  Pharmacopoeia: Introduction to IP, BP, USP, NF and Extra Pharmacopoeia. Salient features of Indian Pharmacopoeia

HISTORY OF THE PROFESSION OF PHARMACY IN INDIA IN RELATION TO PHARMACY EDUCATION

- The word Pharmacy is derived from the Greek word **'PHARMAKON'** meaning drug.
- In the ancient period, the physician themselves practiced pharmacy and it is believed that Hippocrates, the great Greek physician, regard as father of Medicine, used to make his own prescription or at least, supervise their preparation.
- The opening of a **chemist shop in 1811** by Scotch in Bathgate, Kolkata was the start of pharmacy profession in India.

- In 1870, a training programme for the chemists was started by the Madras Medical College which was later converted to a Diploma programme.
- Pharmacy education in India at the certificate level was started in 1842 in the name of **ESCOLE MEDICO DE GOA** at Goa by the Portuguese.

- Formal training of the compounds was started in 1881in Bengal.
- The systematic and well-defined University education was initiated in 1932 when the Banaras Hindu University pioneered the pharmaceutical education under the guidance of Professor Mahadeva Lal Schroff, the father of pharmaceutical education in India. Pharmaceutical Chemistry was introduced as a subject in the B.Sc. Degree course in this year.
- A two year course of B.Sc. pharmaceutics was also introduced later. This further lea to the introduction of a three year **Bachelor of Pharmacy course** in 1937 at the **Banaras Hindu University.** The programs of studies included Pharmacognosy, Pharmaceutical Chemistry and German & Pharmaceutical Economics. In 1940, a Master of Pharmacy research Degree program was also introduced.

- In Baghdad the first pharmacies or drug store, were established in 754 AD.
- In 1944 **graduate course in pharmacy** started at Punjab University, Lahore (currently in Pakistan).

Indian Pharmacopoeia

- Indian Pharmacopoeia Headquarter - **Ghaziabad (Uttar Pradesh).**
- After publication of Indian Pharmacopoeial list the government of India constituted a permanent Indian Pharmacopoeia committee in 1948.

Edition	Year	Addendum	Chairmanship	Volume
1st	1955	1960	Dr. B. N. Ghose	1
2nd	1966	1975	Dr. B. Mukherjee	1
3rd	1985	1989/ 1991	Dr. Nityanand	2
4th	1996	2000/ 2002/ 2005	Dr. Nityanand	2
5th	2007	2008	Dr. Nityanand	3
6th	2010	2012	Shri K Chandramouli	3
7th	2014	2015/ 2016	Nabi Azad	4
8th	2018	2019/ 2021	Dr. C.K. Mishra	4

1st Edition

Indian Pharmacopoeia committee under chairmanship of Dr. B.N. Ghosh published First Edition of Indian Pharmacopoeia in 1955.

Salient features of first edition of Indian Pharmacopoeia (1955)

1. The titles of monograph have been given in Latin language. Abbreviated titles have been given immediately below the Latin title.
2. The English title has also been given below the abbreviation title.
3. The weights and measures have been given in metric system.
4. Doses are expressed both in metric as well as in the English system.
5. A list of preparations has been expressed in Celsius thermometric scale.
6. The exact solubility of a Pharmacopeial substance is not known.

2nd Edition

Indian Pharmacopoeia committee under chairmanship of Dr. B Mukerji published Second Edition of Indian Pharmacopoeia in 1966.

Salient feature of the Second Edition of Pharmacopoeia of India (1966)

1. The titles of monographs have been changed from Latin to English.
2. The words of the title have been changed to give the name of the drug first e.g., injection of Aminophylline changed to Aminophylline Injection.
3. Doses are expressed in the metric system only.
4. Solubility is expressed in part of solvent per unit part of solute.
5. The test for sterility has been modified to provide for detection of fungi.
6. New analytical techniques such as non-aqueous titrimetry, coloum chromatography have been included.
7. In the monographs of tablets and Injections a new sub-heading Usual Strength has been given.

3rd Edition

Indian Pharmacopoeia committee under chairmanship of Dr. Nityanand published third Edition of Indian Pharmacopoeia in 1985.

This Pharmacopoeia include two Addendum with two Volumes.

Addendum (Volume-1) [1989] - They contain legal notice prephase acknowledgement, Introduction, General notice and monographs from A to P. They contain 46 new monographs added and 126 amended.

- A publication of the General Medical Council (UK) describing and establishing standards for medicines, preparations, materials and articles used in the practice of medicine, surgery and midwifery.

History of British Pharmacopoeia

- The first list of approved drugs with information on how they should be prepared was the **London Pharmacopoeia** published in **1618.**
- In 1907 the British Pharmacopoeia was supplemented by the **British Pharmaceutical Codex**, which gave information on drugs and other pharmaceutical substances not included in the BP, and provided standards for these.
- The British Pharmacopoeia is composed of **six volumes** which contains nearly **3,000 monographs** for drug substances, excipients and formulated preparation, together with supporting General Notices, **Appendices** (test methods, reagents etc.) and Reference Spectra used in the practice of medicine, all comprehensively indexed and cross-referenced for easy reference.

British pharmacopoeia has six volumes as given under:

- Volumes I and II: Medicinal Substances.
- Volume III Formulated Preparations, Blood related Preparations. Immunological Products. Radiopharmaceutical Preparations, Surgical Materials, and Homeopathic Preparations
- Volume IV: Appendices. Infrared Reference Spectra and Index.
- Volume V: British Pharmacopoeia (Veterinary).
- Volume VI: (CD-ROM version), British Pharmacopoeia, British Pharmacopoeia (Veterinary), and British Approved Names.

MARTINDALE EXTRA PHARMACOPOEIA

- The Extra Pharmacopoeia originally produced by **William Martindale in 1883** and published by the **Pharmaceutical Society of Great Britain.**
- It contains information d the drugs currently used in Great Britain.
- It is a reference book listing 6,000 drugs and medicine used worldwide, including descriptions of more than 180,000 proprietary preparations.
- It also includes nearly 700 disease treatment reviews.
- Martindale contains information on drugs use in clinical worldwide, as well a selected investigational and veterinary drug, herbal and complementary medicines pharmaceutical excipients, vitamins and nutritional agents, radiopharmaceuticals, contrast media and diagnostic agents, medicinal gases, drugs of abuse and recreational drugs, toxic substances, disinfectants and pesticides.
- It aims to provide practicing pharmacists and physicians with up-to-date information on all drug substances, official unofficial and proprietary, that are currently used in pharmacy. The Extra Pharmacopoeia has been made available in the form of a **CD-ROM database.**

The History of Martindale: The Extra Pharmacopoeia

- **In 1868:** Writing for the Pharmaceutical Journal. Martindale was publishing papers and answering pharmacists' questions. Recognising the need for a single source of up-to-date information he began to envision a new publication for pharmacists.
- **In 1883:** A pocket-sized volumes of 313 pages, the 1st edition of The Extra Pharmacopoeia of Unofficial Drugs and Chemical and Pharmaceutical Preparations were published, authored by William Martindale with Dr. W. Wynn Westcott who provided medical commentary and references.
- **In 1889:** William Martindale was elected to the council of the Pharmaceutical Society, serving as its president from 1899 to 1900.

- Sand (silicon dioxide) Soda ash (sodium carbonate) Limestone (calcium carbonate) Cullet (broken glass) aluminium, boron, potassiuum, magnesium, zinc, barium.
- **Amber:** light yellowish to deep reddish brown, carbon and sulphur or iron and manganese dioxide.
- **Yellow:** Compounds of cadmium and sulphur.
- **Blue:** Various shades of blue, cobalt oxide or occasionallycopper (cupric) oxide
- **Green:** iron oxide, manganese dioxide and chromium dioxide.

Types of Glass

TYPE	DESCRIPTION	CHARACTERISTICS	GENERAL USE
Type I	**Borosilicate glass**	Highly resistant and chemically inert glass. Alkalis and earth cations of glass are replaced by boron and/or aluminum and zinc. These are used to contain strong acids and alkalis.	Buffered and unbuffered aqueous solution
Type II	**Treated soda lime glass**	These are more chemically inert than Type I glass. The glass surface is de-alkalized by "Sulphur treatment" which prevents blooming/weathering from bottles.	It is suitable for most acidic and neutral aqueous preparations. (Solution containing pH below or equal to 7)
Type III	**Regular soda lime glass**	Untreated soda lime glass with average chemical resistance	Dry powder and Oleaginous solution
Type IV	**General Purpose soda lime glass**	Not used for parenteral, used only for products intended to be used orally or topically.	Not for parenteral, used for tablet, capsule, oral solution or suspensions

TYPES OF GLASS	GENERAL DESCRIPTION	TYPE OF TEST	TEST LIMIT	
			SIZE (ml)	ml OF 0.02N H_2SO_4
I	**Highly resistant borosilicate glass**	Powdered glass	All	1.0
II	**Treated soda - lime glass**	Water Attack	100 ml or less	0.7
			Over 100 ml	0.2
III	**Soda -lime glass**	Powdered glass	All	8.5
IV (NP)	**General purpose soda lime glass**	Powdered glass	All	15.0

Advantages of glass packaging

1. Glass containers are mainly used in the packaging of liquid preparations due to their rigidity and their superior protective properties:
2. Glass high transparency allows easy inspection of its contents. Glass provides better protection because it is relatively impermeable to air and moisture. Glass is chemically resistance to most medicinal products.
3. Coloured glass (amber glass and red coloured glass) can protect its content from ultraviolet rays and certain wavelengths.

Chapter 4

UNIT OPERATION

Definition, objectives/applications, principles, construction, and workings of:

- **Size reduction:** hammer mill and ball mill
- **Size separation:** Classification of powders according to IP, Cyclone separator, Sieves and standards of sieves
- **Mixing:** Double cone blender, Turbine mixer, Triple roller mill and Silverson mixer homogenizer
- **Filtration:** Theory of filtration, membrane filter and sintered glass filter
- **Drying:** working of fluidized bed dryer and process of freeze drying
- **Extraction:** Definition, Classification, method, and applications

SIZE REDUCTION

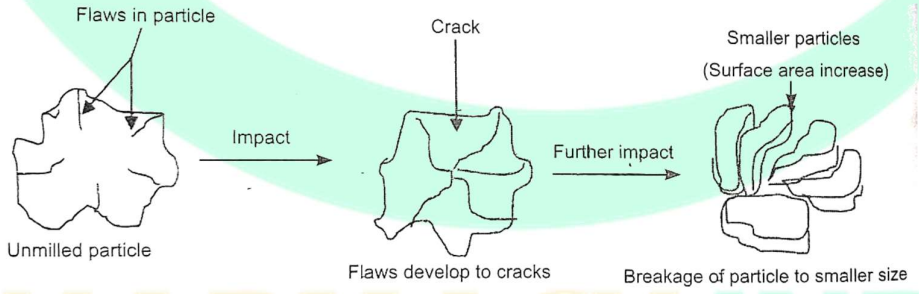
Introduction

- Size reduction is defined as **the process of reducing the large particles into smaller particles, coarse particles and coarse particle into fine, and fine particles breakdown into very fine particles size**.
- **COMMINUTION** is another term used for size reduction.

Objectives of size reduction

- Size reduction leads to increase of surface area For example, the rate of dissolution of soliddrug particles increases many folds after size reduction.
- Size reduction produces particles in narrow size range. Mixing of powders with narrowsize range is easier.
- In the manufacturing of tablets relatively few drugs can be compressed directly.

Mechanism of size reduction

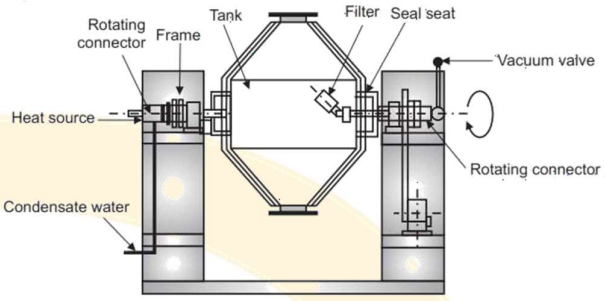


1. **Cutting:** The material is cut by means of sharp blade(s). **Example:** Cutter mill
2. **Compression:** The material is crushed by the application of pressure. **Example:** Roller mill.
3. **Impact:** The force with which one thing hits another or with which two objects collide or striking the moving particles at a stationary surface. In either case, the material is reducedinto small pieces**. Example:** Hammer mill.

- The conical shape at both ends allows uniform mixing and easy discharge.

Working:

- The powder is filled up to two-thirds of the volume of the blender to ensure proper mixing.
- The rate of rotation should be 30-100 revolutions per minute. On rotation, mixing occurs due to tumbling motion.
- The product can be discharged from the bottom of the equipment.



- The mixing tank can be slanted freely at the angle of 0° to 360° degrees for dischargingand cleaning purposes.

Advantages:

1. Easy to maintain and clean
2. There are no chances of clogging of material into comers
3. A large amount can be handled easily
4. It is efficient for mixing powders of different densities
5. Wear on equipment is little

Disadvantages:

1. Not suitable for fine particles
2. Not suitable for particles with greater particle size difference due to less shear

Application:

1. Double Cone Blender is efficient and versatile equipment for the homogeneous mixing of dry powders and granules. Dry powder mixing for tablets and capsule formulations.
2. It can be used for pharmaceutical, food, chemical, and cosmetic products, etc.

TURBINE MIXER

Principle:

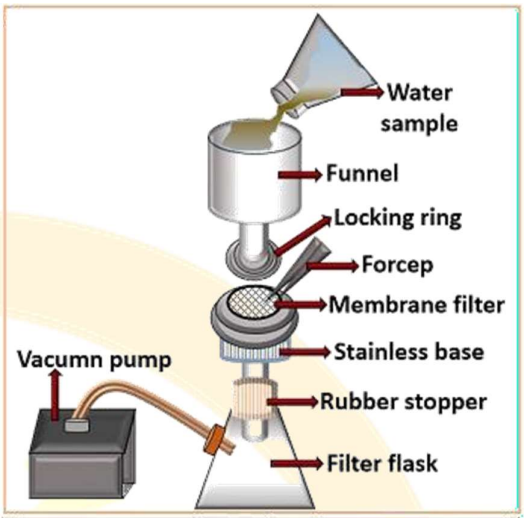
- Turbine mixer agitators can create a turbulent movement of the fluids due to the combination of centrifugal and rotational motion.
- These combined motions cause effective mixing of low to medium viscosity fluids.

Construction:

- A turbine consists of a circular disc to which a number of short blades are attached.
- Compared to propellers, the diameter of turbines is approximately 0.13-0.67 to that ofthe diameter of the vessel.
- The blades may be straight, pitched, curved, or disk type.
- The turbine rotates at a slower speed, usually 50–200 r.p.m. than the propellers.
- Flat blade turbines produce radial and tangential flow, but as the speed increases, radialflow dominates.
- A pitched blade turbine produces axial flow.
- Shear produced by turbines can be further enhanced using a diffuser ring. The diffuserring is a stationary perforated ring that surrounds the turbine.

Working:

- The membrane filter functions like a sieve and thus removes particles.
- The filter of 0.010-0.10µ pore sizes remove even viruses from water or air, and filter of 0.30-0.65µ pore sizes remove bacteria.
- Filter with largest pore sizes (0.8, 1.2. 3.0-5.0u) is used in aerosol radio activity and particle sizing applications.
- For sterile filtration, the membrane is autoclaved in the holder and to prevent curling they are packed between thick filters.Some membrane filters which are pre- sterilised (by ethylene oxide or ionising radiation) are also available.
- A rigid base of perforated metal, plastic, or coarse sintered glass is used to support the membrane filter during filtration process (as in the case of fibrous pad filters).



MEMBRANE FILTRATION UNIT

Advantages:

1) It does not allow bacterial growth.
2) It can be easily disposed off.
3) It does not allow any cross contamination.
4) Since adsorption is negligible, it does not impart any fibres or alkali into the filtrate.
5) Its filtration rate is rapid.

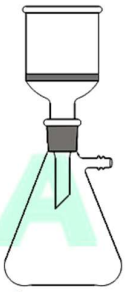
Disadvantages:

1) It may get clogged.
2) If ordinary, it is less resistant to solvents like chloroform.

Uses:

1) It is used for enhanced recovery of particular gram-positive organisms.
2) It is used for filtration of enzyme solution
3) It is used for diagnostic cytology
4) It is used for receptor binding studies.
5) It is used as a clarifying filter.
6) It is used for sterilizing and clarifying aqueous and organic solvents including buffers microbiological and tissue culture solutions.

SINTERED GLASS FILTER



Principle:

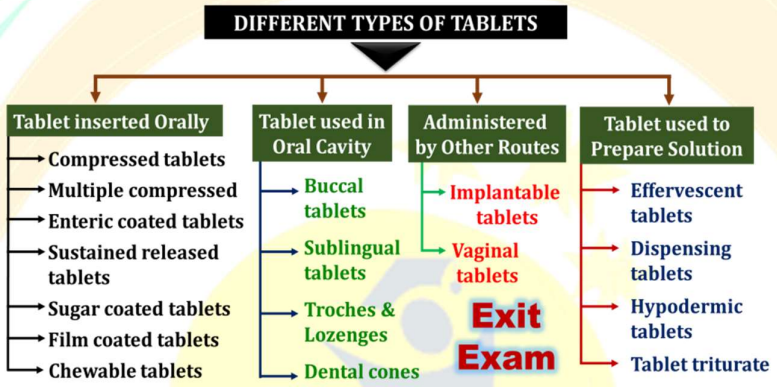
- It is works on the principle of Reducing pressure.
- During the filtration high pressure exerts on the sintered glass disc and lower pressure exert on the base of funnel.

Construction:

- It consists of the glass funnel and sintered glass disc.
- These filters have as a filtering medium a flat or convex plate of Jenna glass powdered and shifted to produce granules of uniform size that are molded together.
- The variation in porosity depending on size of granules used in the plate.

- Drugs which are amorphous and low-density character are difficult to make tablet.
- Hygroscopic drugs are not suitable for compressed tablets.
- Drugs with low or poor water solubility, slow dissolution, and high absorption in GI tractmay be difficult to formulate.
- Cost of production may be increased because of coating and encapsulation to removebitter and unpleasant taste.
- Difficult to swallow in case of children and unconscious patients.

Types of Tablets



Uncoated Tablet

- Uncoated tablets are generally single-layer tablets prepared by a single compression of granules or multi-layer tablets consisting of parallel layers prepared by compression of granules of different compositions.
- No treatment is given to such tablets after compression.
- Any added substances are not specifically intended to modify the release of their active ingredients.
- The addition of flavors to uncoated tablets other than multi-layer tablets is not official unless permitted in the individual monograph.

1. Compressed Tablets

- Compressed tablets represent a significant proportion of tablets that are clinically used to provide systemic administration of therapeutic agents either in an uncoated state (i.e., in their simplest form) or in a coated state.
- These tablets are designed to provide rapid disintegration in the gastric fluid following ingestion hence, allowing rapid release of the drug and, ultimately, systemic absorption of the dosage form.
- Compressed tablets are formed by compression of powdered, crystalline, or granular materials into the required geometry by the application of high pressures, utilizing steel punches and die.
- Examples of compressed tablets include tablets for oral, buccal, sublingual, or vaginal administration.

2. Multiple Compressed Tablets

- Multiple compressed tablets are prepared by compressing the material more than once. These are known as multiple layered tablets or tablet within tablet.

3. Effervescent Tablets

They are simply applied on the skin.	They are generally applied with to the spatula or spread on lint.
They are used as protective or emollient for the skin.	They form a protective coating area where it is applied.

Creams

- Creams are defined as a semisolid dosage form containing one or more drug substances dissolved or dispersed in a suitable base.
- Creams are homogeneous preparations consisting of opaque emulsion systems.
- Their consistency and rheological properties depend on the type of emulsion either water-in-oil (w/o) or oil-in-water (o/w) and on the nature of the solids in the internal phase.
- Creams are intended for application to the skin or certain mucous membranes for protective, therapeutic, or prophylactic purposes, especially where an occlusive effect is not necessary.

Classification of Creams

1. Hydrophobic creams (w/o) –

- ✓ Hydrophobic creams are usually anhydrous and absorb only small amounts of water. E.g., Cold cream.
- ✓ They contain w/o emulsifying agents such as wool fat, sorbitan esters, and monoglycerides.
- ✓ **Formula of cold cream –**

Ingredient	Quantity
Bees wax	16 gm
Liquid paraffin	50 gm
Borax	0.8 gm
Water	33.2 gm
Perfume and preservative	q.s.

2. Hydrophilic creams (o/w) –

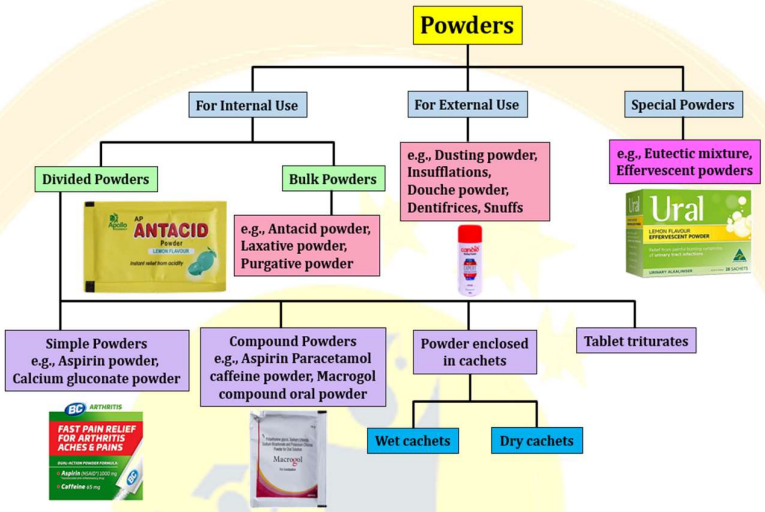
- ✓ Hydrophilic creams contain bases that are miscible with water. E.g. Vanishing cream.
- ✓ They also contain o/w emulsifying agents such as sodium or triethanolamine soaps, sulfated fatty alcohols, and polysorbates combined, if necessary, with w/o emulsifying agents.
- ✓ These creams are essentially miscible with skin secretions.
- ✓ **Formula of vanishing cream –**

Ingredient	Quantity
Stearic acid	18 gm
Glycerin	3 gm
Lanolin	2 gm
Triethanolamine	1 gm
Water	80 ml
Preservative	1gm

Applications of Creams

- Granules are the aggregation of fine particles of powder into a mass of approximately spherical shape. The process by which these granules are prepared is commonly known as granulation. Granulation of powders is frequently carried out during pharmaceutical manufacturing to improve the bulk properties of the starting materials. Granulation can be carried out with or without the use of water and is called dry or wet granulation.

Classification of Powders



Insufflations

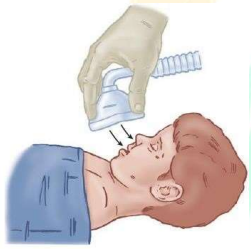
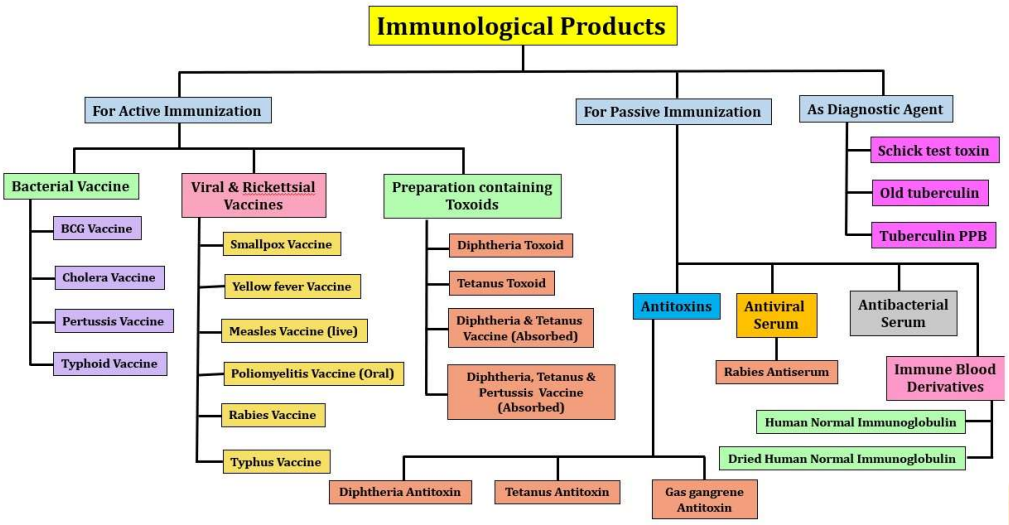


FIGURE 3–2 Insufflation of an anesthetic agent across a child's face during induction.

- These are medicated dusting powders meant for introduction into the body cavities such as nose, throat, cars and vagina with the help of an apparatus known as "insufflator".
- It sprays the powder into a stream of finely divided particles all over the site of application.
- The following difficulties are however generally faced while using the insufflators:-
    1. It is difficult to obtain a measured quantity of the drug as a uniform dose.
    2. It gets blocked when it is slightly wet or the powder used is wet.
- Insufflations should be in finely divided powders so that a stream of fine particles of medicaments gets applied to the site of application.
- Nowadays, the insufflations are available in the form of pressure aerosols.
- These are used for administration of potent drugs. This method has the advantage of excellent control of dose through metered valves.
- Moreover, it also protects the product from external environment.
- Insufflations are used to produce a local effect, as in the treatment of ear, nose and throat infection with antibiotics or to produce a systemic effect from a drug that is destroyed in the gut.

Dusting Powders

- These are meant for external application to the skin and are generally applied in a very fine state of sub division to avoid local Hence, dusting powders should be passed through sieve no. 80 to enhance their effectiveness.
- Dusting powders are of two types: -



Sera

- Serum – fluid with solid components of blood which don't clot.
- Plasma – Clotting factor (fibrinogen) = Serum

Classification of Serum Preparation

Homologous Serum	Heterologous Serum
• Serum obtained from blood donors, volunteers have been immunized. • Provide immunity in 4-6 weeks. • E.g., Immunosera (antisera), Human immunoglobulin	• Serum obtained from blood of animals (horse) who are hyperimmunized. • Provide immunity in 2-3 weeks. • E.g., Tetanus antitoxin, Diphtheria antitoxin

Serum Immune Derivatives

1. Immune Sera
2. Human Immunoglobulin

Immune Sera

- Serum that contains Abs for specific antigen called antisera.
- 2 types
  1. **Monovalent** – serum containing Abs specific for one antigen.
  2. **Polyvalent** – serum containing Abs specific for more than one antigen.

Immune Sera Preparation